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(54) **METHOD AND SYSTEM FOR IN-VEHICLE FUNCTION CONTROL**

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B60W 50/08	(2012.01)

(52) **U.S. Cl.**

CPC ***B60W 50/08*** (2013.01); ***B60K 35/00*** (2013.01)

(58) **Field of Classification Search**

CPC B60K 35/00; H04W 48/02; H04W 48/08; H04W 4/04; H04M 1/6083; H04M 1/6091; H04M 1/72577; G06F 17/00

USPC 701/36, 37, 465; 340/426.1, 426.11, 340/905

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,394,136	A	2/1995	Lammers et al.	
6,026,784	A	2/2000	Weisman et al.	
6,225,890	B1	5/2001	Murphy	
6,366,848	B1	4/2002	Gustavsson	
6,701,234	B1	3/2004	Vogelsang	
7,024,306	B2	4/2006	Minami et al.	
7,027,621	B1	4/2006	Prokoski	
7,375,624	B2	5/2008	Hines et al.	
7,627,422	B2	12/2009	Adamczyk et al.	
7,782,181	B2	8/2010	Hines et al.	
8,706,349	B2 *	4/2014	Rector et al.	701/36
8,751,104	B2 *	6/2014	Hermann et al.	701/36
2003/0182033	A1	9/2003	Underdahl et al.	
2004/0210353	A1	10/2004	Rice	
2006/0038690	A1	2/2006	Shmerling et al.	
2008/0243558	A1	10/2008	Gupte	
2009/0210295	A1	8/2009	Edholm et al.	
2010/0004818	A1	1/2010	Phelan	
2010/0045451	A1	2/2010	Periwal	
2010/0045452	A1	2/2010	Periwal	
2011/0106370	A1	5/2011	Duddle et al.	
2011/0244890	A1	10/2011	Lehmann et al.	
2011/0254655	A1	10/2011	Maalouf et al.	
2012/0021386	A1	1/2012	Anderson et al.	
2012/0185282	A1	7/2012	Gore et al.	
2013/0338914	A1 *	12/2013	Weiss	701/465

* cited by examiner

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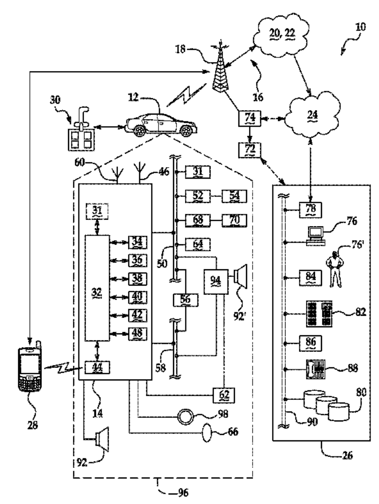
(57) **ABSTRACT**

A method and a system for in-vehicle function control are disclosed herein. In an example of the method, an in-vehicle controller recognizes that a predetermined driver is operating a vehicle. The in-vehicle controller receives data from at least one vehicle system, the data being indicative of a driving behavior of the predetermined driver. The in-vehicle controller compares the data with any of i) positive metrics or ii) negative metrics to categorize the driving behavior. In response to the categorized driving behavior, a signal is provided. In response to the signal, access is granted to any of (i) an infotainment function or (ii) an increased number or range associated with an infotainment function, if the categorized driving behavior is associated with a predetermined number of the positive metrics.

16 Claims, 2 Drawing Sheets



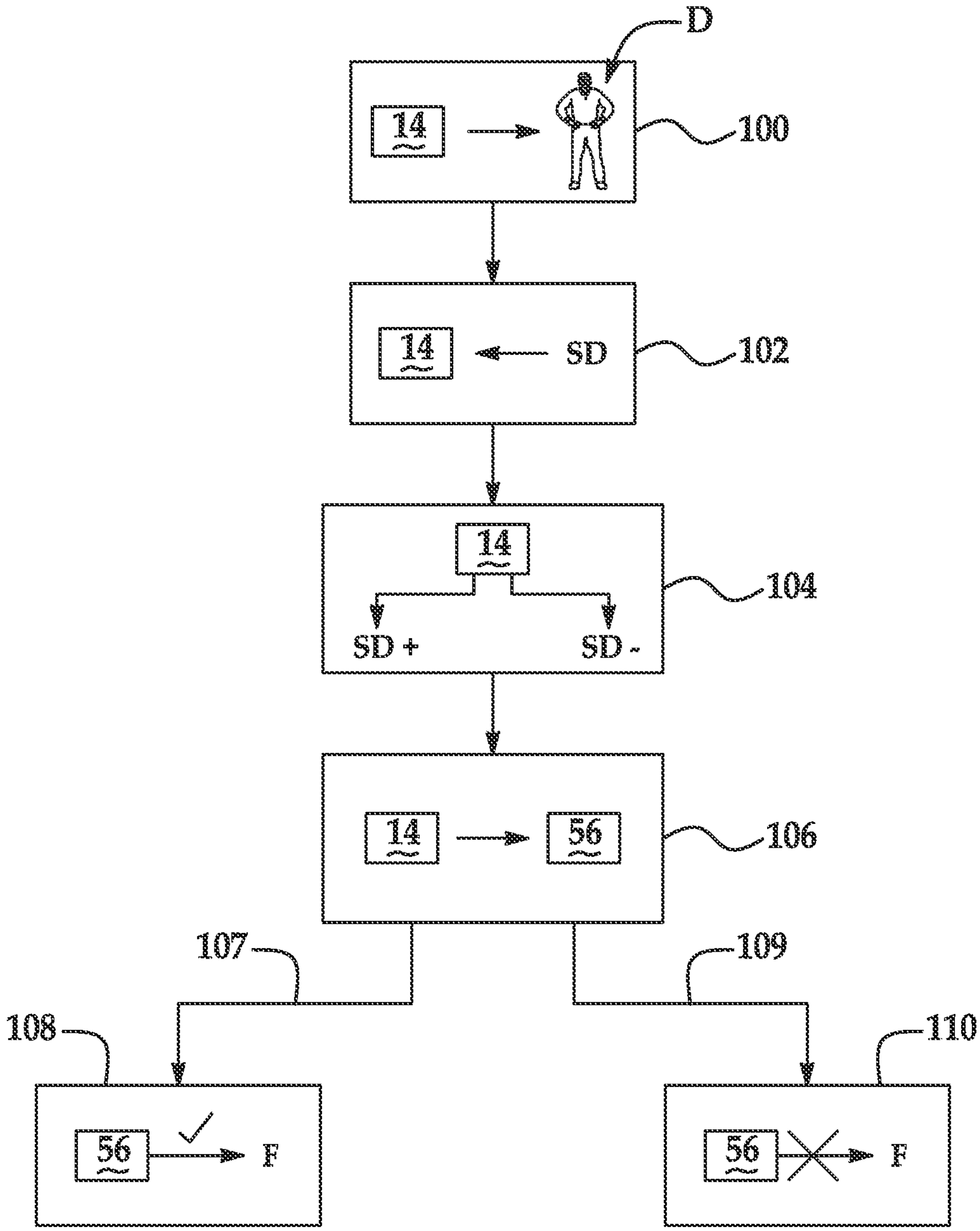


FIG. 1

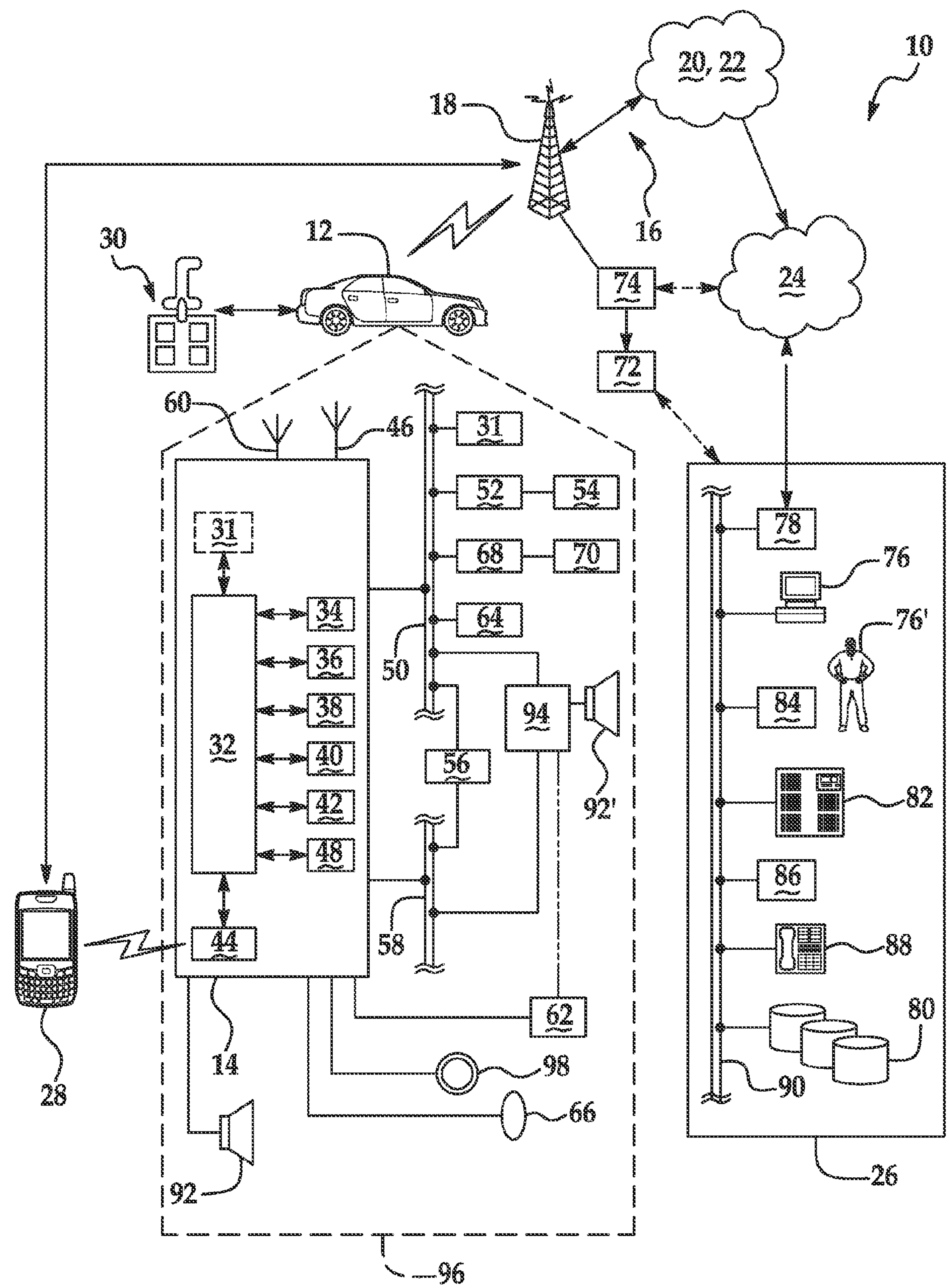

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FIG. 2

METHOD AND SYSTEM FOR IN-VEHICLE FUNCTION CONTROL

TECHNICAL FIELD

The present disclosure relates generally to a method and system for in-vehicle function control.

BACKGROUND

Vehicles may be equipped with telematics units or other in-vehicle controllers that enable hands free calling, vehicle tracking, navigation instruction transmission, and other like features. Telematics units or other in-vehicle controllers may also be configured to activate vehicle settings that are personal to the vehicle user. A user may select desirable settings and configure the telematics unit or other in-vehicle controller from within the vehicle or remotely from the vehicle (e.g., via an Internet-enabled program).

SUMMARY

A method and a system for in-vehicle function control are disclosed herein. In an example of the method, an in-vehicle controller recognizes that a predetermined driver is operating a vehicle. The in-vehicle controller receives data from at least one vehicle system, the data being indicative of a driving behavior of the predetermined driver. The in-vehicle controller compares the data with any of i) positive metrics or ii) negative metrics to categorize the driving behavior. In response to the categorized driving behavior, a signal is provided. In response to the signal, access is granted to any of (i) an infotainment function or (ii) an increased number or range associated with an infotainment function, if the categorized driving behavior is associated with a predetermined number of the positive metrics.

BRIEF DESCRIPTION OF THE DRAWINGS

Features and advantages of examples of the present disclosure will become apparent by reference to the following detailed description and drawings, in which like reference numerals correspond to similar, though perhaps not identical, components. For the sake of brevity, reference numerals or features having a previously described function may or may not be described in connection with other drawings in which they appear.

FIG. **1** is a schematic flow diagram illustrating an example of the method for in-vehicle function control; and

FIG. **2** is a schematic diagram depicting an example of a system for in-vehicle function control.

DETAILED DESCRIPTION

Example(s) of the method disclosed herein may be used to reward drivers in real-time with infotainment-related privileges or other in-vehicle or vehicle usage privileges. In the examples disclosed herein, data from vehicle system(s) is monitored and evaluated in order to determine whether the driving behavior exhibited by the driver qualifies the driver for an in-vehicle or vehicle usage reward. The categorization of the driving behavior may be based upon the data that is received during a particular driving event, and this data may be used either alone or in combination with the driver's driving behavior history. The use of real-time driving event data and associated rewards may provide an incentive for the vehicle driver to exhibit a particular driving behavior, and

may also provide positive reinforcement for the vehicle driver when he/she does exhibit the particular driving behavior.

It is to be understood that the terms "connect/connected/connection" and/or the like are broadly defined herein to encompass a variety of divergent connected arrangements and assembly techniques. These arrangements and techniques include, but are not limited to (1) the direct communication between one component and another component with no intervening components therebetween; and (2) the communication of one component and another component with one or more components therebetween, provided that the one component being "connected to" the other component is somehow in operative communication with the other component (notwithstanding the presence of one or more additional components therebetween).

Furthermore, the term "communication" is to be construed to include all forms of communication, including direct and indirect communication. As such, indirect communication may include communication between two components with additional component(s) located therebetween.

FIG. **1** depicts an example of the in-vehicle function control method, which may be performed to monitor the driving behavior of the vehicle driver D during a driving event in order to potentially reward the driver D for his/her driving behavior, and FIG. **2** depicts an example of a system **10** that may be used to carry out the method. FIGS. **1** and **2** will be discussed together throughout the following description.

It is to be understood that the overall architecture, setup and operation, as well as many of the individual components of the system **10** shown in FIG. **2** are generally known in the art. It is to be understood, however, that additional components and/or other systems not shown here could employ the method(s) disclosed herein.

As shown in FIG. **2**, the system **10** includes a mobile vehicle **12**, an in-vehicle controller **14** operatively disposed in the mobile vehicle **12**, a carrier/communication system **16** (including, but not limited to, one or more cell towers **18**, one or more base stations **20** and/or mobile switching centers (MSCs) **22**, and one or more service providers (not shown) including mobile network operator(s)), one or more land networks **24**, and one or more call centers **26**.

Vehicle **12** is a mobile vehicle, such as a motorcycle, car, truck, recreational vehicle (RV), boat, plane, etc., and is equipped with suitable hardware and computer-readable instructions that enable it to communicate (e.g., transmit and/or receive voice and data communications) over the carrier/communication system **16**. In an example, the carrier/communication system **16** is a two-way radio frequency communication system. The wireless carrier/communication system **16** may be used to establish communication between the in-vehicle controller **14** and any outside communications device or system (e.g., a mobile phone, a landline telephone, component(s) at the call center **26**).

Examples of the method disclosed herein may be initiated by an ignition on event. When the vehicle ignition is turned on, the in-vehicle controller **14** initiates the method and attempts to recognize the current vehicle driver D. This is shown at reference numeral **100** in FIG. **1**. Recognition of the current vehicle driver D may be accomplished in a variety of ways. In an example, the in-vehicle controller **14** in conjunction is capable of identifying the vehicle driver D. As will be discussed in further detail below, the in-vehicle controller **14** may identify the vehicle driver D using a mobile communications device **28** operatively connected to the in-vehicle controller **14**, a key fob **30** used for vehicle entry and/or vehicle operation, video recognition, voice recognition, an off-board server (e.g., a server **82** at the call center **26**) in communication with the in-vehicle controller **14**, or the like.

The in-vehicle controller **14** is an on-board vehicle dedicated communications device (e.g., a telematics unit) that includes hardware components that are capable of running computer-readable instructions, which are embodied on non-transitory, tangible computer-readable media. The computer-readable media may include any one of many physical media such as, for example, electronic, magnetic, optical, electromagnetic, or semiconductor media. More specific examples of suitable computer-readable media include hard drives, a random access memory (RAM), a read-only memory (ROM), an erasable programmable read-only memory (EPROM), or a portable CD, DVD, or flash drive. Examples of the computer-readable instructions may be for recognizing the driver D, for comparing data with metrics to categorize driving behavior, or for carrying out other steps of the method disclosed herein.

To identify the vehicle driver D, the in-vehicle controller **14** may include or otherwise be in connection with (via a vehicle bus **50**) a module **31**, which may be any computational box that is configured to make the identification(s). Examples of the module **31** include a body control module (BCM), a human machine interface (HMI), and/or the like. In some instances, the module **31** includes a speech-recognition unit and/or an in-vehicle camera.

The in-vehicle controller **14** also provides a variety of other services, both individually and through its communication with the call center **26**. In an example, the call center **26** is a facility that may be owned and operated by an in-vehicle controller service provider (e.g., a telematics service provider). The in-vehicle controller **14** generally includes an electronic processing device **32** operatively coupled to one or more types of electronic memory **34**, a cellular chipset/component **36**, a wireless modem **38**, a navigation unit containing a location detection (e.g., global positioning system (GPS)) chipset/component **40**, a real-time clock (RTC) **42**, a short-range wireless communication network **44** (e.g., a BLUETOOTH® unit), and/or a dual mode antenna **46**. Generally, dual mode antenna **46** services the location detection chipset/component **40** and the cellular chipset/component **36**. It is to be understood that the in-vehicle controller **14** may be implemented without one or more of the above listed components (e.g., the real-time clock **42**). It is to be further understood that in-vehicle controller **14** may also include additional components and functionality as desired for a particular end use.

The electronic processing device **32** (also referred to herein as the processor **32**) may be a micro controller, a controller, a microprocessor, a host processor, and/or a vehicle communications processor. In another example, electronic processing device **32** may be an application specific integrated circuit (ASIC). Alternatively, electronic processing device **32** may be a processor working in conjunction with a central processing unit (CPU) performing the function of a general-purpose processor. In an example, the electronic processing device **32** is capable of running software programs having computer-readable code/instructions to initiate and/or perform one or more steps of the method disclosed herein. For instance, the software programs may include computer-readable instructions for comparing data received by the in-vehicle controller **14** with preset metrics stored in the memory **34**.

The location detection chipset/component **40** may include a Global Position System (GPS) receiver, a radio triangulation system, a dead reckoning position system, and/or combinations thereof. In particular, a GPS receiver provides accurate time and latitude and longitude coordinates of the vehicle **12** responsive to a GPS broadcast signal received from a GPS satellite constellation (not shown).

The cellular chipset/component **36** may be an analog, digital, dual-mode, dual-band, multi-mode and/or multi-band cellular phone. The cellular chipset-component **36** uses one or more prescribed frequencies in the 800 MHz analog band or in the 800 MHz, 900 MHz, 1900 MHz and higher digital cellular bands. Any suitable protocol may be used, including digital transmission technologies, such as TDMA (time division multiple access), CDMA (code division multiple access) and GSM (global system for mobile telecommunications). In some instances, the protocol may be short-range wireless communication technologies, such as BLUETOOTH®, dedicated short-range communications (DSRC), or Wi-Fi.

Also associated with electronic processing device **32** is the previously mentioned real-time clock (RTC) **42**, which provides accurate date and time information to the in-vehicle controller **14** hardware and software components that may require and/or request date and time information. In an example, the RTC **42** may provide date and time information periodically, such as, for example, every ten milliseconds.

The electronic memory **34** of the in-vehicle controller **14** may be configured to store computer-readable instructions to be executed by the processor **32**, data associated with the various systems of the vehicle **12** and/or the various drivers of the vehicle, positive and/or negative metrics for categorizing driving behavior, vehicle operations, vehicle user preferences and/or personal information, and the like.

In some examples, the in-vehicle controller **14** may also include a vehicle data upload (VDU) system **48**, which is configured to receive raw vehicle data from the vehicle bus **50** (discussed further below), packetize the data, and upload the packetized raw data to the call center **26** or another external entity (such as the vehicle owner). In one example, the VDU system **48** is operatively connected to the processor **32** of the in-vehicle controller **14**, and thus is in communication with the external entity via the bus **50** and the carrier/communication system **16**. In another example, the VDU **48** may be the in-vehicle controller's central data system that can include a modem, a processor, and an on-board database. The database can be implemented using a separate network attached storage (NAS) device or can be located elsewhere, such as in memory **34**, as desired. The VDU system **48** has an application program that handles the vehicle data upload processing, including communication with any external entity and the setting and processing of triggers which initiate a data upload event.

The in-vehicle controller **14** provides numerous services alone or in conjunction with the call center **26**, some of which may not be listed herein, and is configured to fulfill one or more user or subscriber requests. Several examples of these services include, but are not limited to: turn-by-turn directions and other navigation-related services provided in conjunction with the GPS based chipset/component **40**; airbag deployment notification and other emergency or roadside assistance-related services provided in connection with various crash and or collision sensor interface modules **52** and sensors **54** located throughout the vehicle **12**; and infotainment-related services where music, Web pages, movies, television programs, videogames and/or other content is downloaded by an in-vehicle infotainment controller **56** operatively connected to the in-vehicle controller **14** via vehicle bus **50** and an audio bus **58**. The listed services are by no means an exhaustive list of all the capabilities of in-vehicle controller **14**, but are simply an illustration of some of the services that the in-vehicle controller **14** is capable of offering.

As mentioned above, the in-vehicle controller **14** is capable of recognizing the then-current driver D of the vehicle **12** in a variety of ways. In an example, the in-vehicle controller **14** may identify the vehicle driver D using the mobile communications device **28** of the driver D. When the driver D brings his/her mobile communications device **28** into the vehicle **12**, the short range wireless communication network **44** (e.g., the BLUETOOTH® unit) may pair the mobile communications device **28** with the in-vehicle controller **14**. In an example, the in-vehicle controller **14** continuously monitors for the presence of the mobile device **28** (which may be identified by a unique media access control (MAC) identifier) using a short range wireless antenna **60**, and attempts to pair the device **28** with the in-vehicle controller **14** upon recognizing the MAC. The mobile device **28** and the in-vehicle controller **14** are actually paired when the in-vehicle controller **14** and the mobile device **28** exchange security codes/passwords with each other. Pairing enables the in-vehicle controller **14** and the mobile device **28** to communicate typically under a secured connection. Once the two units **14**, **28** have been initially paired, the in-vehicle controller **14** can directly communicate with the mobile device **28** if desired.

During the initial pairing process, the user of the mobile communications device **28** may have the opportunity to enter identification information that will associate him/her with the mobile communications device **28**. This identification information may be communicated to and stored in the in-vehicle controller **14**. During subsequent pairings, the in-vehicle controller **14** will recognize device **28** and the user associated with the device **28**. When the mobile communications device **28** is the only device recognized in the vehicle **12** after an ignition on event, the in-vehicle controller **14** is capable of concluding that the user of the mobile communications device **28** is also the vehicle driver D. However, when multiple mobile communications devices **28** are recognized in the vehicle **12** after an ignition on event, the in-vehicle controller **14** may be configured to contact one or more of the users associated with the respective devices **28** to determine which of the users is the then-current driver D. For example, when both a mom and a child of driving age have entered the vehicle **12**, the in-vehicle controller **14** recognizes the respective mobile devices **28** of both the mom and the child. In this example, the in-vehicle controller **14** may transmit a message to an application on the mobile device **28** of the mother asking if she is the driver D. In this same example, the in-vehicle controller **14** may otherwise transmit a message, using an in-vehicle display **62**, to all in-vehicle occupants asking which of the occupants is the driver D. The in-vehicle controller **14** may also be configured to utilize the location of the mobile communications device **28** to triangulate who is where within the vehicle cabin and/or utilize seat weight sensor data to determine who is where within the vehicle cabin. Multiple techniques may be combined in order to correctly identify the driver D.

The display **62** may be operatively directly connected to or in communication with the in-vehicle controller **14**, or may be part of the in-vehicle infotainment controller **56**. Examples of the display **62** include a VFD (Vacuum Fluorescent Display), an LED (Light Emitting Diode) display, a driver information center display, a radio display, an arbitrary text device, a heads-up display (HUD), an LCD (Liquid Crystal Diode) display, and/or the like.

In another example, the in-vehicle controller **14** may identify the vehicle driver D using the module **31** and the key fob **30**. In this example, the module **31** (using the processor **32** or its own processor) executes computer-readable instructions for identifying the key fob **30** that had previously been associated with the driver D. A single key fob **30** may, for example, be personalized for a single vehicle driver D so that the module **31** can identify the driver D when the key fob **30** is used. In instances where the vehicle **12** has several possible drivers D, each driver D may have his/her own personal key fob **30** that is recognizable by the module **31**. In an example, each key fob **30** includes an internal processor (not shown) and a memory (also not shown) configured to store information personal to the vehicle driver previously associated or registered with the key fob **30**.

When the key fob **30** is actuated by the vehicle driver D to initiate a vehicle function and when the electronics of the vehicle **12** are started, the in-vehicle controller **14** queries the module **31** for information associated with the key fob **30** that was used to actuate the previously-described vehicle function. The module **31** responds to the query by identifying a rolling code of the key fob **30**, synchronizing the rolling code with an identifier of the key fob **30**, and then accessing the vehicle driver information associated with the identified key fob **30**. The module **31** thereafter transmits a message back to the in-vehicle controller **14** over the vehicle bus **50** with the identifier of the key fob **30** and the information about the driver D associated with the key fob **30**. Alternatively, the module **31** may place a message on the vehicle bus **30** containing the identifier and the driver information, and the in-vehicle controller **14** may retrieve the message.

In instances where the module **31** is embedded in or integrated with the in-vehicle controller **14**, the in-vehicle controller **14** itself identifies the key fob **30** that was used to actuate the vehicle function and the driver associated with the key fob **30**. This may be accomplished by the in-vehicle controller **14** in the same way as the module **31** (i.e., by identifying the rolling code of the key fob **30**, and then synchronizing the rolling code with the key fob identifier, and then accessing the information associated with the identified key fob **30**).

The in-vehicle controller **14** may also be capable of recognizing the driver D using video recognition or voice recognition. Video recognition may be accomplished by spatially recognizing the vehicle driver's physical features, such as the shape, color, and features of the driver's face. In an example, a facial imaging camera **64** may be positioned inside the vehicle **12** such that the camera **64** faces or is operable to face the driver's seat. For example, the camera **64** may be positioned on the dashboard, on the rearview mirror, on the steering wheel, or the like. The camera **64** may be used to take images or video of the person that is then-currently occupying the driver's seat. In some cases, the camera **64**, via a processor operatively associated therewith (not shown) or via the processor **32**, may have been trained to recognize the driver. For example, each time the vehicle **12** is powered on, the camera **64** captures an image or video of the vehicle driver D. Upon capturing the image or video, the in-vehicle controller **14** may request that the vehicle driver D input identifying information, to be associated with the image or video, using a microphone **66**, the display **62**, or another input device operatively connected to the in-vehicle controller **14**. This information may be stored with the image in the memory **34** or a memory of the camera **64**. At the initiation of a driving event (e.g., ignition on), the camera **64** can ascertain an image of the vehicle driver D and cross-check the image with images and information previously stored to identify the vehicle driver D.

Voice recognition may be accomplished by requesting the vehicle driver D to verbally recite an utterance into the microphone **66** that is operatively connected to the in-vehicle controller **14**. The utterance may include information identifying the person who is occupying the driver's seat, such as the persons' name. The in-vehicle controller **14** may then use the person's name to identify the driver. In another example, the in-vehicle controller **14** may use voice recognition software to recognize the person who is speaking based on a comparison of the person's utterances with a previously stored voice print of the user.

The previously mentioned microphone **66** provides an in-vehicle occupant with a means for inputting verbal or other auditory commands, and can be equipped with an embedded voice processing unit utilizing human/machine interface (HMI) technology known in the art. Conversely, speaker(s) **92**, **92'** provides verbal output to the vehicle occupants and can be either a stand-alone speaker **92** specifically dedicated for use with the in-vehicle controller **14** or can be part of a vehicle audio component **94** (see speaker **92'**). Microphone **66** and speaker(s) **92**, **92'** enable vehicle hardware **96** and the call center **26** to communicate with the occupants through audible speech.

The audio component **94** is operatively connected to the vehicle bus **50** and the audio bus **58**. The audio component **94** receives analog information, rendering it as sound, via the audio bus **58**. Digital information is received via the vehicle bus **50**. The audio component **94** provides AM and FM radio, satellite radio, CD, DVD, multimedia and other like functionality in conjunction with the infotainment controller **56**. The audio component **94** may contain a speaker system, or may utilize speaker **92**, **92'** via arbitration on vehicle bus **50** and/or audio bus **58**.

The vehicle hardware **96** also includes one or more buttons, knobs, switches, keyboards, and/or controls **98** for enabling a vehicle occupant to activate or engage one or more of the vehicle hardware components. In one example, one of the buttons **98** may be an electronic pushbutton used to initiate voice communication with the call center **26** (whether it be a live advisor **76** or an automated call response system **76'**) to request emergency services, for example.

The driver D may also be recognized by an off-board server, such as a server **82** at the call center **26**. In-vehicle parameters (e.g., seat position, mirror positions, etc.) are often unique to a particular driver D. The in-vehicle controller **14** may communicate these parameters to the server **82**, which can access driver profiles to determine who the driver D is based upon the parameters.

Any combinations of the driver identification methods may also be used. Still further, other driver identification methods not discussed herein are believed to be within the scope of the instant disclosure.

In any instance, the owner of the vehicle **12** may be contacted to verify who is or had been driving during a particular driving event.

Once the driver D is recognized, the information about who is driving during this particular driving event may be transmitted to the call center **26**. This may be desirable so that the call center **26** (using one or more of its various components which are discussed below) may store vehicle data SD transmitted from the vehicle **12** during the driving event, and/or may retrieve a driving history for the driver D and transmit the driving history to the vehicle **12** during the driving event.

Referring back to the method shown in FIG. **1**, in an example, once the driver D is recognized, the in-vehicle controller **14** enters a monitor mode. In another example, the in-vehicle controller **14** may enter monitor mode at the onset of a driving event and before the driver D is recognized. During monitor mode, data SD from at least one vehicle system is received at the in-vehicle controller **14**, as shown at reference numeral **102** of FIG. **1**. When the in-vehicle controller **14** is continuously in monitor mode after an ignition on event, the data SD collected may not be transmitted outside of the vehicle **12** (e.g., to the call center **26** or another third party) until after the driver D is identified.

The in-vehicle controller **14** is connected to the various vehicle systems through the vehicle bus **50**. The vehicle bus **50** may utilize a variety of networking protocols, such as a controller area network (CAN), a media oriented system transfer (MOST), a local interconnection network (LIN), an Ethernet or TCP/IP, and other appropriate connections such as those that conform with known ISO, SAE, and IEEE standards and specifications, to name a few. The vehicle bus **50** enables the vehicle **12** to send signals (i.e., real-time bus messages) from the in-vehicle controller **14** to various units of equipment and systems both outside the vehicle **12** and within the vehicle **12** to perform various functions, such as unlocking a door, executing personal comfort settings, and/or the like. The vehicle bus **50** also enables the vehicle **12** to receive signals at the in-vehicle controller from various units of equipment and systems both outside the vehicle **12** and within the vehicle **12**.

While the in-vehicle controller **14** may receive a variety of data SD from a variety of vehicle systems, the data that is of particular interest in the method(s) disclosed herein is data SD that is indicative of the driving behavior of the driver D. Examples of this data SD include vehicle boundary data, following distance data, vehicle speed data, vehicle braking data, vehicle acceleration and deceleration data, and/or lane drift data. It is to be understood that other data SD indicative of driving behavior may be received and utilized in the method(s) disclosed herein. The data SD that is available and utilized may depend, at least in part, on the sensor suite that is present in the vehicle **12**.

As previously mentioned, the data SD is received by the in-vehicle controller **14** from one or more vehicle systems. The vehicle systems may include the crash and or collision sensors **54** and other vehicle sensors **70**. The crash sensors **54** provide information to the in-vehicle controller **14** via the crash and/or collision detection sensor interface **52** regarding the severity of a vehicle collision, such as the angle of impact and the amount of force sustained. The vehicle crash and/or collision detection sensor interface **52** is/are operatively connected to the vehicle bus **50**. The other vehicle sensors **70**, connected to various sensor interface modules **68**, are also operatively connected to the vehicle bus **50**. Examples of the other vehicle sensors **70** include, but are not limited to, gyroscopes, accelerometers, magnetometers, emission detection and/or control sensors, lane departure sensors (e.g., video sensors, laser sensors, infrared sensors, etc.), speed sensors, following distance sensors (e.g., radar sensors, video sensors, infrared sensors, ultrasonic sensors, etc.), braking activity sensors, environmental detection sensors, and/or the like. Examples of the sensor interface modules **68** include powertrain control, climate control, body control, and/or the like.

During a driving event, the sensors **54**, **70** continuously collect real-time data SD. The data SD may be collected continuously or at predetermined time intervals (e.g., every 30 seconds, every minute, every five minutes, etc.) and then sent to the in-vehicle controller **14** at the end of the predetermined time interval. As such, in a single driving event, the respective sensors **54**, **70** may send multiple data messages. Each message may be associated with a time stamp so that the in-vehicle controller **14** is aware of when the data SD was collected. In an example, the data SD is transmitted in the form of a message to the in-vehicle controller **14** over the vehicle bus **50**. In another example, the data SD is placed as a message on the vehicle bus **50** and the in-vehicle controller **14** retrieves the message.

The data SD is processed in order to classify the overall driving behavior. In an example, the data SD received by the in-vehicle controller **14** is compared with positive metrics and/or negative metrics in order to categorize the driving behavior of the driver D. This is shown at reference numeral **104** of FIG. **1**. All received data SD may be input into an algorithm (run by the processor **32**) which evaluates the data SD and runs comparisons with previously set positive and/or negative metrics, and then uses the algorithm outputs in order to classify the driving behavior. As such, in many instances, no one positive or negative metric alone would define the driving behavior.

The positive and negative metrics may be identified using threshold values. In some instances, the threshold value is a desirable minimum value, and any value that exceeds that threshold value may be considered a positive metric while any value that is below that threshold may be considered a negative metric. For example, if a minimum following distance is set at five feet, any distance greater than five feet is a positive metric and any distance equal to or less than five feet is a negative metric. In other instances, the threshold value is a desirable maximum value, and any value that exceeds that threshold value may be considered a negative metric while any value that is below that threshold may be considered a positive metric. For example, a maximum number of lane drifts for any driving event (regardless of its duration) may be set at five. In this example, any number of lane drifts less than five is considered a positive metric, and any number of lane drifts equal to or greater than five is considered a negative metric.

The positive and negative metrics may also be identified using standard curves. For example, every acceleration/deceleration curve created for the driver D could be compared to standard curves for acceleration/deceleration at various speeds. If the curves match the standard, the acceleration/deceleration may be classified as corresponding with a positive metric, and if the curves do not match the standard, the acceleration/deceleration may be classified as corresponding with a negative metric. For example, if the driver D is driving at 55 mph and brakes to a complete stop, his/her curves would be compared to known safe braking curves.

The positive and negative metrics may also be identified using threshold values in conjunction with a time period. For example, excessive braking may be quantified using an acceptable number of braking events taking place within a set time period. For example, excessive braking may be defined as ten or more braking events within a 30 second time period. In this example, any number of braking events that is less than ten in the set time period is a positive metric and any number of braking events that is equal to or greater than ten within the set time period is a negative metric.

The positive and negative metrics may also be identified using ranges. For example, positive and negative metrics related to speed may be based a range surrounding the posted speed limit. If the range is set to ±5 mph of the posted speed limit, then any speed within the range is a positive metric and any speed outside of the range is a negative metric. The range may also be a geo-boundary. A preset geo-boundary may be identified for the driver D, and travel outside of the boundary will be a negative metric while travel within the boundary will be a positive metric.

Metrics may be set for one data type or for a plurality of data types. The in-vehicle controller **14** will have any metrics stored therein (e.g., in memory **34**) and thus will be able to determine which data SD should be used in a comparison. The positive and/or negative metrics may be set by the manufacturer of the vehicle **12**, by the owner of the vehicle **12**, and/or by a parent or guardian of the driver D (who may also the owner of the vehicle **12** or has permission from the owner to set the metrics). As noted above, the various metrics may be used in combination in an algorithm in order to classify the overall driving behavior. In this regard, no one particular data type would control the classification. Rather, various data types may be individually compared with preset positive and/or negative metrics and then may be combined in order to classify the overall driving behavior.

The metrics may be set using a webpage **72**, the information of which resides on computer equipment (not shown) of a host server **74**. The webpage **72** may be owned and/or operated by an in-vehicle controller service provider or a vehicle manufacturer. This webpage **72** may be used, e.g., to set up the metrics for a particular driver D. Different drivers D of the same vehicle **12** may have different metrics associated therewith. For example, a vehicle owner may set no metrics for himself or his spouse, but he may set one of set metrics for his teenager driver and another set of metrics for his elderly mother.

The vehicle owner or other authorized person may access the page **72** by, e.g., submitting personal (e.g., a login ID) and authenticating information (e.g., a password, a PIN, etc.). The computer equipment used to log into the webpage **72** may also include hardware, which, for example, can receive and read a smart card for identification/authentication purposes, or can utilize biometrics for identification/authentication purposes. Once the webpage **72** has been accessed, the person accessing the webpage **72** (which is typically an authorized user of the vehicle **12**) may input driver D information and select particular metrics to be associated with that driver D. A preset list of metrics may be available for selection on the webpage **72**. In some instances, fillable fields may also be available to input information for defining a particular metric.

In addition, the webpage **72** may be used to register a particular key fob **30** with a particular driver D and/or to register a particular mobile communications device **28** with a particular driver D for subsequent driver identification (as discussed above). In these cases, the user submits identification information of the key fob **30** and/or mobile device **28** (e.g., its serial number, phone number, etc.), and indicates (e.g., via a mouse click on an appropriate icon or menu option on the webpage **72**) to associate the key fob **30** and/or device **28** with the identified driver **30**.

Any information set using the webpage **72** may be sent from the webpage **72** to the vehicle **12** for storage therein (e.g., in memory **34** or a memory of the module **31**), and/or may be sent to the call center **26** for storage in its memory device(s).

The metrics may also be set by placing a call to the call center **26**, and submitting a request to an advisor **76**, **76'** to set one or more metrics for one or more drivers D of the vehicle **12**. A call to the call center **26** may also be used to register a key fob **30** and/or a mobile communications device **28** with a particular driver D of the vehicle **12**. More specifically, the call is received at a switch **78**, which directs the call to an appropriate advisor **76**, **76'** at the call center **26**. Upon authorizing the caller (e.g., who accurately responds to a number of challenge questions), the caller may submit the driver information and any metrics that are to be associated with the identified driver. The call center advisor **76**, **76'** inputs the information and transmits the information for storage in a user profile in a database **80**. In an example, the advisor **76**, **76'** may access the webpage **72** and input driver information and metric information (e.g., as if the caller had accessed the webpage **72** himself/herself). The information may also be transmitted to the vehicle **12** for storage therein.

The metrics are generally set until the authorized user accesses the webpage **72** (or calls the call center **26**), and removes or otherwise changes the preset metrics associated with a particular driver D. The removed/changed preset conditions will take effect as soon as they are stored in the in-vehicle controller **14**, and remain as active preset metrics until changed by the user, or the user's subscription with the call center **26** expires or is canceled, or for a duration predefined by the user. It is further to be understood that authorized persons alone are allowed to remove/change the preset metrics (e.g., Mom and Dad may be authorized to remove/change the preset metrics associated with their son, whereas their son may not be authorized). Those that are authorized to remove/change the preset metrics are pre-established by the user who originally set up a subscription account, or by others who the user has indicated as being authorized to change the preset metrics. Those that are authorized to remove/change the preset metrics may be identified, by the user, when the preset metrics are originally set up and/or may be added or removed at any subsequent time.

Vehicle communications (e.g., between the vehicle **12** and the webpage **72**, between the vehicle **12** and the call center **26**) generally utilize radio transmissions to establish a voice channel with carrier system **16** such that both voice and data transmissions may be sent and received over the voice channel. Vehicle communications are enabled via the cellular chipset/component **36** for voice communications and the wireless modem **38** for data transmission. In order to enable successful data transmission over the voice channel, wireless modem **38** applies some type of encoding or modulation to convert the digital data so that it can communicate through a vocoder or speech codec incorporated in the cellular chipset/component **36**. It is to be understood that any suitable encoding or modulation technique that provides an acceptable data rate and bit error may be used with the examples disclosed herein.

A portion of the carrier/communication system **16** may be a cellular telephone system or any other suitable wireless system that transmits signals between the vehicle hardware **96** and land network **24**. According to an example, the wireless portion of the carrier/communication system **16** includes one or more cell towers **18**, base stations **20** and/or mobile switching centers (MSCs) **22**, as well as any other networking components required to connect the wireless portion of the system **16** with land network **24**. The wireless portion of the carrier/communication system **16** further includes other supporting systems, including SMSCs or short message service controllers, which are systems specifically designed to send, deliver, and/or transmit SMS or text messages to a desired destination.

A communications service provider generally owns and/or operates the carrier/communication system **16**. The communications network provider includes a mobile network operator that monitors and maintains the operation of the communications network. The network operator directs and routes calls, and troubleshoots hardware (cables, routers, network switches, hubs, network adaptors), software, and transmission problems. It is to be understood that, although the communications network provider may have back-end equipment, employees, etc. located at the call center **26**, the call center **26** is a separate and distinct entity from the network provider. In an example, the equipment, employees, etc. of the communications network provider are located remote from the call center **26**. The communications network provider provides telephone and/or Internet services, while the telematics service provider provides a variety of telematics-related services (such as, for example, those discussed hereinabove). It is to be understood that the communications network provider may interact with the call center **26** to provide services (such as emergency services) to the vehicle user(s).

It is to be understood that various cell tower/base station/MSC arrangements are possible and could be used with the wireless portion of the system **16**. For example, a base station **20** and a cell tower **18** may be co-located at the same site or they could be remotely located, or a single base station **20** may be coupled to various cell towers **18**, or various base stations **20** could be coupled with a single MSC **22**. A speech codec or vocoder may also be incorporated in one or more of the base stations **20**, but depending on the particular architecture of the wireless network **16**, it could be incorporated within an MSC **22** or some other network components as well.

Land network **22** may be a conventional land-based telecommunications network that is connected to one or more landline telephones and connects the wireless portion of the carrier/communication network **16** to the service center **26**. For example, land network **22** may include a public switched telephone network (PSTN) and/or an Internet protocol (IP) network. It is to be understood that one or more segments of the land network **24** may be implemented in the form of a standard wired network, a fiber or other optical network, a cable network, other wireless networks such as wireless local networks (WLANs) or networks providing broadband wireless access (BWA), or any combination thereof.

The call center **26** is designed to provide the vehicle hardware **96** with a number of different system back-end functions. According to the example shown in FIG. **2**, one call center **26** generally includes one or more switches **78**, servers **82**, databases **80**, live and/or automated advisors **76**, **76'**, processing equipment (or processor) **84**, a communications module **86**, as well as a variety of other telecommunication and computer equipment **88** that is known to those skilled in the art. These various call center **26** components are coupled to one another via a bus **90**, such as one similar to the vehicle bus **50** previously described.

The processor **84**, which is often used in conjunction with the computer equipment **88**, is generally equipped with suitable software and/or programs enabling the processor **84** to accomplish a variety of call center **26** functions. The various operations of the call center **26** are carried out by one or more computers (e.g., computer equipment **88**). The computer equipment **88** (including computers) may include a network of servers (including server **82**) coupled to both locally stored and remote databases (e.g., database **80**) of any information processed. In an example, the processor **84** executes computer software for receiving and processing the vehicle data SD received from the in-vehicle controller **14** during a VDU event. The processor **84** is capable of storing the vehicle data SD to generate a history of driving behavior for a particular driver D.

In an example, the communications module **86** includes suitable communications equipment that enables the call center **26** to establish a communication with an outside entity. This equipment may, for instance, be capable of handling voice calls, packet data sessions, or other messaging-based communications between the call center **26** and outside entities.

Switch **78**, which may be a private branch exchange (PBX) switch, routes incoming signals so that voice transmissions are usually sent to either the live advisor **78'** or the automated response system **78**, and data transmissions are passed on to a modem or other piece of equipment (not shown) for demodulation and further signal processing. The modem preferably includes an encoder, as previously explained, and can be connected to various devices such as the server **82** and database **80**.

It is to be appreciated that the call center **26** may be any central or remote facility, manned or unmanned, mobile or fixed, to or from which it is desirable to exchange voice and data communications. As such, the live advisor **78'** may be physically present at the call center **26** or may be located remote from the call center **26** while communicating therethrough.

Again referring back to reference numeral **104** in FIG. **1**, the comparison of the data SD with the positive metrics (+) and/or negative metrics (−) may be accomplished by the processor **32** of the in-vehicle controller **14** running computer-readable instructions. The appropriate raw data SD is compared to the metric(s) associated with that type of data to categorize the driving behavior. The comparison may be accomplished to determine if the data SD matches a value that is labeled as a positive metric or a negative metric. In an example, the comparison may involve a numerical comparison, where the data SD is compared with a numerical value that is respectively assigned to the positive and/or negative metric. As examples, actual speed data may be compared with an appropriate speed range to determine if the actual speed matches a positive metric or a negative metric; actual lane drift data may be compared with a maximum number of allowed lane drafts to determine if the actual number of lane drifts matches a positive metric or a negative metric; and/or actual vehicle position data may be compared with a preset geo-boundary to determine if the vehicle ever ventured outside of the geo-boundary and thus matches a negative metric.

When a single data type is analyzed, the in-vehicle controller **14** may categorize the driving behavior as good, great, acceptable, etc. if the data matches a positive metric and bad, unacceptable, etc. if the data matches a negative metric.

When multiple data types are analyzed, the in-vehicle controller **14** may determine how much of the data matches positive metrics and how much of the data matches negative metrics. This may be accomplished by an algorithm run by the processor **32**. In an example, the amount of data that matches the positive metrics will indicate the category of the driving behavior. In an example, a preset number of positive metrics may have to be matched in order to categorize the driving behavior as good, great, acceptable, etc. For example, if seven different types of data SD are analyzed, a preset categorization scale may indicate that i) if 6-7 of the types of raw data SD match positive metrics, the driving behavior is to be labeled as good driving behavior (e.g., level green), ii) if 4-5 of the types of raw data SD match positive metrics (and the remainder match negative metrics), the driving behavior is to be labeled as mediocre driving behavior (e.g., level yellow), and iii) if 3 or less of the types of raw data SD match positive metrics (and the remainder match negative metrics), the driving behavior is to be labeled as bad, unacceptable, etc. driving behavior (e.g., level red).

The algorithm used to analyze the data SD may perform straight comparisons with the preset metrics and then may combine the outputs to categorize the driving behavior. The algorithm may also apply a weighting scheme to the outputs that is based upon preset driving behavior rankings and/or may evaluate driving patterns taking place during the driving event that are indicative of a particular driving behavior.

The comparison of the data may involve the data from single driving event alone. This may be used to categorize the driving behavior during the single driving event. In this example, a rolling average of the metric(s) may be taken over an integral of time. For example, the data SD received may be

compared to determine the matching metric for that data. For some time period, all of the metrics may be averaged to determine the category of the driving behavior. For example, if seven different types of data SD are analyzed and data is received every 10 minutes, the in-vehicle controller **14** may be programmed to run comparisons for each data set that is received (at 10 minutes, 20 minutes, 30 minutes, etc.), and to generate an average after 30 minutes. In this example, if the first data set indicates that all seven of the data types in the first set (received after 10 minutes) match positive metrics, the second data set indicates that five of the seven data types in the second set (received after 20 minutes) match positive metrics, and the third data set indicates that six of the seven data types in the third set (received after 30 minutes) match positive metrics, then the rolling average for the 30 minute period is 6 positive metrics ((7+6+5) metrics/3 intervals). The rolling average may be re-calculated at different intervals throughout the driving event to categorize the overall driving behavior.

The comparison of the data with the metrics from the single driving event may also be combined with a driving history of the driver D in order to categorize the driving behavior. In this example, the driving history of the driver D may be sent from the call center **26** to the in-vehicle controller **14** in the form of reports including previously assigned driving behavior categories and previous comparison of data and metrics. In an example, the in-vehicle controller **14** may be programmed to generate a Gaussian average of the driving performance based upon the then-current data SD being received and compared with the previous data. This provides a cumulative driving behavior categorization. Other methods for generating a cumulative driving behavior categorization may also be utilized.

The comparison of the data with the preset metrics may also be set to take into account isolated instances that match negative metrics when a bulk of the data matches positive metrics. For example, multiple sets of data SD may be received over various time intervals, and only the data set for one of intervals includes speed, lane drift, and acceleration data that correspond with respective negative metrics. In this example, the in-vehicle controller **14** may recognize that an incident may have occurred during that particular interval since this type of behavior was not observed at any of the other time intervals. The in-vehicle controller **14** may be programmed to ignore the comparison for this time interval when categorizing the driving behavior using a rolling average.

While various examples for categorizing or classifying the driving behavior have been described herein, it is to be understood that other methods for categorization or classification may be used.

As shown at reference numeral **106** of FIG. **1**, once the driving behavior is categorized, a signal is sent to the in-vehicle infotainment controller **56**. The signal is indicative of the categorized driving behavior. In some instances (as shown at line **107** in FIG. **1**), the signal will indicate to the in-vehicle infotainment controller **56** that access should be granted to an infotainment function F or to an increased number or range associated with an infotainment function F. In other instances (as shown at line **109** in FIG. **1**), the signal will indicate to the in-vehicle infotainment controller **56** that access should continue to be denied to an infotainment function F or to an increased number or range associated with an infotainment function F. Whether the signal is a grant access signal or a deny access signal will depend upon the categorized driving behavior. For example, if the categorized driving behavior is good, great, acceptable, etc. (e.g., because the data SD matched a predetermined number of positive metrics), the signal that is sent will be a grant access signal. However, if the categorized driving behavior is mediocre or bad, unacceptable, etc. (e.g., because the data SD did not match enough, if any, positive metrics), the signal that is sent will be a deny access signal.

When the signal sent is a grant access signal, the in-vehicle infotainment controller **56** will grant the driver D access to an infotainment function F or to an increased number or range associated with an infotainment function F (as shown at reference numeral **108** in FIG. **1**). It is to be understood that the driver D previously does not have access to the infotainment function F or to the increased number or range associated with an infotainment function F, and thus access to either of these is a reward for good, great, acceptable, etc. driving behavior.

The infotainment function F may be setting a preset radio station; making calls using an in-vehicle hands free calling system; connecting an external music device; in-vehicle uploading to a social media webpage; operating any of a radio or a compact disc player; availability of radio stations; location sharing for social networking; setting vehicle function ringtones; setting wall paper for the in-vehicle display **62**; or combinations thereof. So, for example, when the driver D exhibits good, great, acceptable, etc. driving behavior, he or she may be notified that he/she is now allowed to set a preset radio station, to make calls using the in-vehicle hands free calling system, to connect an external music device (e.g., an MP3 player), to upload to a social media webpage from the vehicle **12**, to share his/her location on the social media webpage utilizing the vehicle **12**, to access previously inaccessible radio stations, to set a vehicle function ringtone, to select and set a particular wall paper for the in-vehicle display **62**, and/or operate the radio and/or the compact disc player. The access to the infotainment function F may be indefinite access, limited access until the driver D exhibits less than suitable driving behavior, or limited access for the driving event.

The increased number or range associated with the infotainment function F may be a number of preset radio stations; a number of calls using an in-vehicle hands free calling system; a number of uploads to a social media webpage; a volume range; a number of accessible radio stations; a number of in-vehicle display wall papers available for selection; a number of ringtones available for selection; a time the radio can be on when driving at a particular speed; or combinations thereof. So, for example, when the driver D exhibits good, great, acceptable, etc. driving behavior, he or she may be notified that he/she is now allowed to set a certain number of preset radio stations; make a certain number of calls using the in-vehicle hands free calling system; upload a certain number of posts, tweets, etc. to a social media webpage; to adjust the volume to a range that was previously not allowed; to access a certain number of radio stations; to select from an expanded list of wall papers and/or ringtones; and/or to have the radio on for a set time period while driving at a particular speed. The access to the increased number or range associated with the infotainment function F may be indefinite access, limited access until the driver D exhibits less than suitable driving behavior, or limited access for the driving event. As an example, if the driver's driving behavior is categorized as positive driving behavior for a predetermined number of driving events, the accessibility to the radio when driving between 45 mph and 50 mph may be enabled. In this example, the speed limit at which the radio stops working may be raised from, for example, 40 mph to 50 mph.

The driver D may be notified of his/her infotainment-related reward by a preset message identifying the reward that is played over the speaker(s) **92**, **92'** or by a visual notification that is present on the in-vehicle display **62**. This message may be delivered in real-time so that the driver D is made aware of his/her reward while the driving event takes place. In an example, the in-vehicle notification may be delivered when the in-vehicle controller **14** recognizes that the vehicle **12** is not motion (e.g., parked, at a red light, etc.). In other instances, the reward may be delivered after a vehicle ignition off event is recognized. In these instances, the message may be sent from the in-vehicle controller **14** to the driver's mobile phone or other electronic device.

When the signal sent is a deny access signal, the in-vehicle infotainment controller **56** will continue to deny the driver D access to particular infotainment functions F or to particular numbers or ranges associated with the infotainment function F.

It is to be understood that the monitoring, comparing, signal sending, and granting or denying access to infotainment-related functions may be continued throughout the driving event until an ignition off event occurs. As such, the categorization of the driving behavior may be updated multiple times throughout a single driving event. A driver D may be rewarded multiple times in a single driving event if the driving behavior is continuously categorized as good, great, acceptable, etc. Similarly, a reward that was given early on during the driving event may be taken away (i.e., access that was granted may be subsequently denied) during the same event if the driving behavior changes drastically toward the negative.

The method may be restarted for each ignition on event that is recognized.

Furthermore, a report of the data SD and the categorization of the driving behavior may be sent to the call center **26** for storage in a profile that is associated with the driver D (which may be a file within the vehicle or vehicle owner profile). The data and categorization may be used by the call center **26** to set up or update the driving history of the driver D.

Reports may also be sent to the vehicle owner and/or parent/guardian who set up the metrics for the driver D. The report may be sent in the form of a diagnostic email, a social media post, a short message service (SMS) or other text message, a multimedia message service (MMS) message, a voice message, and/or the like. In these examples, the report may be sent from the communications module **86** at the call center **26** or from the in-vehicle controller **14**. The report may also be a diagnostic report that is made available on the webpage **72**, where the vehicle or vehicle owner profile that is stored at the call center **26** may be accessed. The reports may be sent in real-time as the driving event is taking place, or they may be sent after the driving event has ended. The vehicle owner and/or parent/guardian who set up the metrics for the driver D may also set up parameters for the format of the reports and the method(s) by which the report(s) should be sent.

While the rewards described herein are related to infotainment-related privileges, it is to be understood that other in-vehicle rewards may be granted. For example, if the driver D is restricted to a particular geo-boundary, the reward may be an expansion of the geo-boundary. Still other examples of vehicle related or vehicle usage rewards include increasing the number of passengers allowed in the vehicle **12**, increasing the time allowed to drive the vehicle **12**, or other in-vehicle or vehicle centric rewards.

Example(s) of the method disclosed herein may be used to reward drivers in real-time with infotainment-related privileges, which provide an incentive for the vehicle driver to exhibit a particular driving behavior, and provide positive reinforcement for the vehicle driver when he/she does exhibit the particular driving behavior.

While several examples have been described in detail, it will be apparent to those skilled in the art that the disclosed examples may be modified. Therefore, the foregoing description is to be considered non-limiting.

The invention claimed is:

1. A method for in-vehicle function control in a vehicle, comprising:

recognizing, by an in-vehicle controller, that a predetermined driver is operating the vehicle;

based upon the predetermined driver, denying access to any of (i) an infotainment function or (ii) an increased number or range associated with an infotainment function;

receiving, in the in-vehicle controller, data from at least one vehicle system, the data being indicative of a driving behavior of the predetermined driver;

in the in-vehicle controller, comparing the data with i) positive metrics and ii) negative metrics to categorize the driving behavior;

recognizing, from the comparison, that the data matches a predetermined number of the positive metrics;

categorizing the driving behavior as positive driving behavior;

providing, in response to the positive driving behavior, a signal; and

responsive to the signal, rewarding the predetermined driver by granting access to any of (i) the previously denied infotainment function or (ii) the previously denied increased number or range associated with the infotainment function.

2. The method as defined in claim **1** wherein in conjunction with the comparing, the method further comprises analyzing a driving history of the predetermined driver to categorize the driving behavior.

3. The method as defined in claim **1** wherein the comparing of the data with the i) positive metrics and ii) negative metrics to categorize the driving behavior includes any of:

comparing the data with a threshold value to determine if the data is associated with the positive metrics or the negative metrics;

comparing the data with a standard curve to determine if the data is associated with the positive metrics or the negative metrics;

comparing the data with a threshold value in conjunction with a time period to determine if the data is associated with the positive metrics or the negative metrics; or

comparing the data with a range to determine if the data is associated with the positive metrics or the negative metrics.

4. The method as defined in claim **1** wherein:

the infotainment function is selected from setting a preset radio station; making calls using an in-vehicle hands free calling system; connecting an external music device; in-vehicle uploading to a social media webpage; operating any of a radio or a compact disc player; availability of radio stations; location sharing for social networking; setting vehicle function ringtones; setting wall paper for an in-vehicle display; and combinations thereof; or

the increased number or range associated with the infotainment function is selected from a number of preset radio stations; a number of calls using an in-vehicle hands free calling system; a number of uploads to a social media webpage; a volume range; a number of accessible radio stations; a number of in-vehicle display wall papers available for selection; a number of ringtones available for selection; a time the radio can be on when driving at a particular speed; and combinations thereof

5. The method as defined in claim **1**, further comprising transmitting a report of the categorized driving behavior using email, a webpage, social media, or an SMS message.

6. The method as defined in claim **1**, further comprising transmitting the data from the at least one vehicle system to the in-vehicle controller in the form of a real-time bus message, the real-time bus message being: related to a preset geo-boundary; related to a following distance of the vehicle; related to vehicle speed; related to vehicle braking; related to any of vehicle acceleration and deceleration; or related to lane drift.

7. The method as defined in claim **1**, further comprising:

receiving, at a webpage, a user-selected positive metric and a user-selected negative metric for the predetermined driver;

transmitting the user-selected positive metric and the user-selected negative metric to the in-vehicle controller; and

storing the user-selected positive metric and the user-selected negative metric in a memory associated with the in-vehicle controller.

8. The method as defined in claim **1**, further comprising notifying the predetermined driver that he/she is being rewarded by playing a message within the vehicle or by displaying a message on an in-vehicle display.

9. The method as defined in claim **1** wherein the data includes speed data, following distance data, lane drift data, acceleration/deceleration data, braking data, and vehicle geographic data, and wherein the comparing of the data with the i) positive metrics and ii) negative metrics to categorize the driving behavior includes:

comparing the speed data with a threshold speed value or an acceptable speed range to determine if the speed data matches the positive metrics or the negative metrics;

comparing the following distance data with a minimum following distance value to determine if the following distance data matches the positive metrics or the negative metrics;

comparing the lane drift data with a threshold lane drift value to determine if the lane drift data matches the positive metrics or the negative metrics;

comparing an acceleration/deceleration curve created for the predetermined driver based upon the acceleration/deceleration data with a standard curve for acceleration/deceleration at a speed to determine if the acceleration/deceleration curve matches the positive metrics or the negative metrics;

comparing the braking data with an acceptable number of braking events in a set time period to determine if the braking data matches the positive metrics or the negative metrics; and

comparing the vehicle geographic data with a geo-boundary range to determine if the vehicle geographic data matches the positive metrics or the negative metrics.

10. The method as defined in claim **9**, wherein the comparing of the data occurs at predetermined time periods during a driving event, and wherein the recognizing that the data matches the predetermined number of the positive metrics includes:

from all of the comparing steps performed at a respective one of the predetermined time periods, determining a total number of matched positive metrics;

determining a rolling average of the matched positive metrics for all of the predetermined time periods; and

determining that the rolling average of the matched positive metrics meets or exceeds the predetermined number of the positive metrics.

11. A system for in-vehicle function control in a vehicle, comprising:

computer-readable instructions, embodied on a non-transitory, tangible computer readable medium, for recognizing that a predetermined driver is operating the vehicle;

at least one vehicle system to transmit data indicative of a driving behavior of the predetermined driver;

an in-vehicle controller to:

compare the data with i) positive metrics and ii) negative metrics to categorize the driving behavior;

recognize, from the comparison, that the data matches a predetermined number of the positive metrics; and

categorize the driving behavior as positive driving behavior; and an in-vehicle infotainment controller to:

initially deny access to any of (i) an infotainment function or (ii) an increased number or range associated with an infotainment function;

receive a signal from the in-vehicle controller in response to the driving behavior being categorized as the positive driving behavior; and

in response to the signal, reward the predetermined driver by granting access to any of (i) the previously denied infotainment function or (ii) the previously denied increased number or range associated with an infotainment function.

12. The system as defined in claim **11** wherein the in-vehicle controller is further to analyze, in conjunction with the comparison, a driving history of the predetermined driver to categorize the driving behavior.

13. The system as defined in claim **11**, further comprising computer-readable instructions, operable by the in-vehicle controller, to compare the data with a threshold value to determine if the data is associated with the positive metrics or the negative metrics.

14. The system as defined in claim **11** wherein:

the infotainment function is selected from setting a preset radio station; making calls using an in-vehicle hands free calling system; connecting an external music device; in-vehicle uploading to a social media webpage; operating any of a radio or a compact disc player; availability of radio stations; location sharing for social networking; setting vehicle function ringtones; setting wall paper for an in-vehicle display; and combinations thereof; or

the increased number or range associated with the infotainment function is selected from a number of preset radio stations; a number of calls using an in-vehicle hands free calling system; a number of uploads to a social media webpage; a volume range; a number of accessible radio stations; a number of in-vehicle display wall papers available for selection; a number of ringtones available for selection; a time the radio can be on when driving at a particular speed; and combinations thereof.

15. The system as defined in claim **11**, further comprising:

a vehicle bus operatively connected to the in-vehicle controller and the at least one vehicle system; and

a real-time bus message including the data and transmitted by the vehicle bus, the real-time bus message being: related to a preset geo-boundary; related to a following distance of the vehicle; related to vehicle speed; related to vehicle braking; related to any of vehicle acceleration and deceleration; or related to lane drift.

16. The system as defined in claim **11**, further comprising:

a webpage in selective communication with the in-vehicle controller, the webpage to receive a user-selected positive metric and a user-selected negative metric for the predetermined driver; and

a memory associated with the in-vehicle controller, the memory to receive and store the user-selected positive metric and the user-selected negative metric.

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